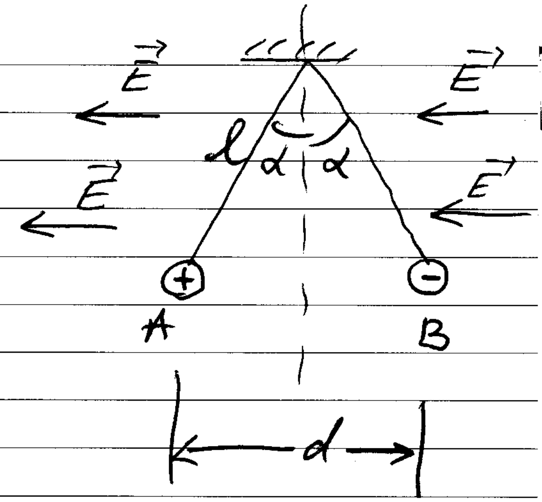
25, 75 from Knight textbook



$|Q_A| = |Q_B| = |Q| = 100\,nC = 10^{-7}\,C$

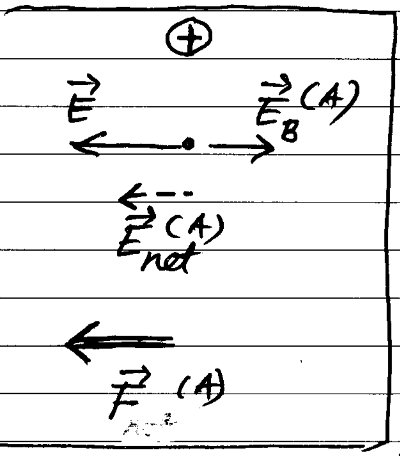
$|\vec E| = 100\,000\ N/C$

$l = 50\,cm,\ \alpha = 10°$

mass of the spheres. $m = ?$

(a) The "field" approach

We calculate the net electric field at the location of each charge

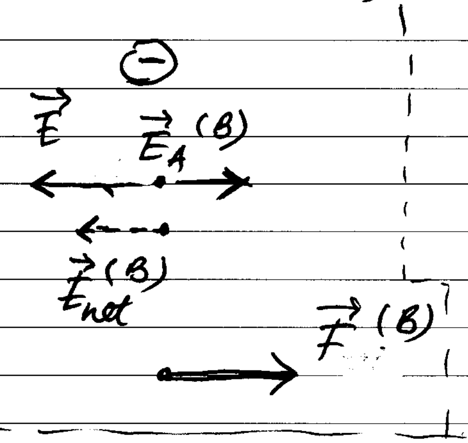


net field at the location of sphere A

$$\vec E_{net}^{(A)} = \vec E + \vec E_B^{(A)}$$

field created by charge B at the location of A

$$\vec F^{(A)} = Q_A \cdot \vec E_{net}^{(A)} = +Q\vec E_{net}^{(A)}$$



net field at location B

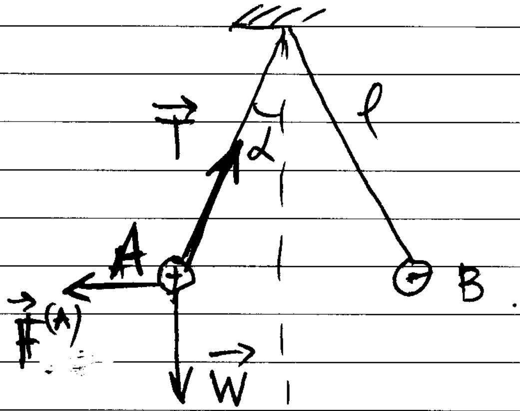
$$\vec E_{net}^{(B)} = \vec E + \vec E_A^{(B)}$$

external field

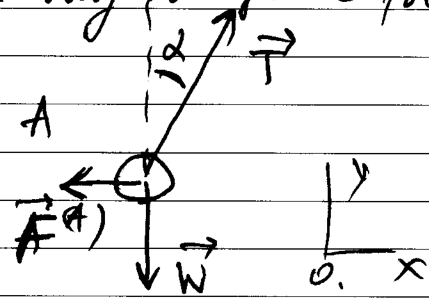
field created by charge A at the location of B

$$\vec F^{(B)} = Q_B \vec E_{net}^{(B)} = -Q\vec E_{net}^{(B)}$$

mechanics problem



free body diagram for A



and similar for B

$$\vec{T} + \vec{F}^{(A)} + \vec{W} = 0$$

$$\left.\begin{aligned} Oy:&\quad T\cos\alpha = W \\ Ox:&\quad T\sin\alpha = F^{(A)} \end{aligned}\right\} \rightarrow \tan\alpha = \frac{F^{(A)}}{W}$$

$$mg = W = \frac{F^{(A)}}{\tan\alpha}$$

$$F^{(A)} = Q_A E_{net}^{(A)} =$$

$$= (+Q)\left(E - k\frac{|Q_B|}{d^2}\right) = EQ - \frac{kQ^2}{d^2}$$

$$m = \frac{F^{(A)}}{g\tan\alpha} = \frac{1}{g\tan\alpha}\left(EQ - \frac{kQ^2}{d^2}\right)$$

$$d = 2l\sin\alpha \Rightarrow m \approx \frac{1}{10\cdot\frac{10}{180}\cdot\pi}\left(10^5\cdot 10^{-7} - \frac{9\cdot 10^9\cdot 10^{-14}}{\frac{\pi^2}{18^2}}\right)$$

$$\approx 1\cdot\frac{10}{180}\cdot\pi$$

$$m \simeq 4\cdot 10^{-3}\ \text{kg}$$

(b) the "force approach": skip the calculation for the net field and start with the forces.